Exploration of the Value of Safety and Construction Technology Management in On-site Construction of Building Engineering

Hongbin He

Anhui Hejiang Construction Engineering Co., Ltd., Hefei, Anhui, 230000, China

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Abstract: In on-site construction of building engineering, safety management and construction technology management are core aspects that ensure project progress, with their collaborative effects being significant. This paper takes safety and construction technology management as the research object. By analyzing the problems faced by current on-site construction management in building engineering, it elaborates in detail on positive countermeasures to strengthen safety and construction technology management on construction sites. It aims to provide effective management references for the construction industry, thereby enhancing on-site safety and technical levels, and ensuring the smooth progress and high-quality completion of engineering projects.

1. Introduction

In the current on-site construction scenarios of building engineering, frequent high-altitude operations, widespread cross-construction by multiple work types, and intensive use of heavy machinery are common occurrences. This makes on-site construction constantly face the dual risks of safety accidents and quality hazards. Meanwhile, as the construction industry gradually transitions towards high-quality development, the industry's requirements for standardized and scientific project management continue to increase. Therefore, how to use systematic and scientific management methods to further improve construction efficiency while ensuring construction safety and engineering quality, and achieving an organic balance among the three, has become a practical issue that the current construction industry must address in its development process.

2. Problems Faced by Current On-site Construction Management in Building Engineering

2.1 Insufficient Synergy in the Management system and Disconnection between Responsibility and Execution

In the current on-site construction management of most building engineering projects, modules such as safety management, technology management, and progress management often operate relatively independently, lacking a unified collaborative mechanism, which leads to breaks in the management process. On the one hand, although the responsibility divisions of each management module are clearly defined in documents, problems of "vague boundaries" tend to occur in actual execution. For example, the results of safety hazard investigations in safety management are not promptly synchronized to the technology management link, resulting in the failure to fully consider safety risks when optimizing technical solutions. Special construction plans formulated by technology management may be forced to be adjusted during the progress management process due to insufficient connection, leading to repeated processes. On the other hand, the "top-down" transmission of the management system shows attenuation. The management standards formulated by the project headquarters are not well-suited to the actual on-site construction conditions. To pursue progress, grassroots managers often simplify management processes, making it difficult for institutional requirements to be implemented. This lack of synergy not only increases management costs but also easily leads to safety and quality hazards, causing deviations between management objectives and actual construction effects.

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2.2 Uneven Comprehensive Literacy of Personnel and Lagging Management Concepts and Abilities

The personnel involved in on-site construction management of building engineering have a relatively complex composition, ranging from coordinating managers and technicians responsible for technology implementation to front-line workers directly participating in operations. There are obvious differences in the literacy levels of personnel in different positions, which brings many constraints to the advancement of on-site management work.

For managers, some have long relied on past construction experience to carry out management work and lack an in-depth understanding of modern management concepts such as full-cycle collaborative management and risk pre-control. When facing unexpected situations or complex demands on the project site, they are unable to quickly adjust management strategies, resulting in a disconnect between management measures and actual construction needs. Among technicians, some do not have a solid grasp of emerging construction technologies and process standards in the industry. When formulating special technical plans or conducting technical disclosures to front-line personnel, they fail to fully consider the safety conditions of on-site construction, causing conflicts between technical plans and safety management requirements during implementation and increasing safety risks.

2.3 Low Adaptability between Technology Application and Management Needs and Lagging Digital Transformation

With the development of the construction industry towards digitalization, various new technologies such as BIM technology and intelligent monitoring equipment are gradually being applied to on-site construction management. However, during the actual application process, the problem of "mismatch between technological functions and management needs" is prominent, failing to fully leverage the supporting role of technology in management.

On the one hand, when introducing new technologies, some enterprises lack systematic planning that combines project actual conditions and focus more on the functions of the technologies themselves rather than making adaptive adjustments according to the specific needs of on-site management. For example, although BIM technology can achieve visual presentation of construction drawings and help technicians more intuitively sort out construction nodes, it lacks an effective linkage mechanism with management links such as on-site safety hazard investigations and construction progress tracking, preventing technological advantages from being transformed into actual management effectiveness and reducing new technologies to "formal tools." On the other hand, the "fragmented" phenomenon of technology application is also very obvious. Different modules of on-site management use independent technological tools, and there is a lack of data interconnection channels between these tools. For example, the risk data collected by the safety monitoring system cannot be shared in real-time with the schedule data in the progress management system, making it difficult for managers to comprehensively grasp the overall status of the project through data integration and unable to promptly identify the associated problems between safety risks and progress delays.

3. The Value of Safety and Construction Technology Management in On-site Construction of Building Engineering

3.1 Building a Solid Safety Line for On-site Construction and Avoiding Risks to Ensure Project Stability

In on-site construction of building engineering, the primary role of safety management is to establish a risk prevention and control system covering the entire construction process, reducing the possibility of safety accidents from the source and laying a foundation for the smooth progress of the project. Specifically, safety management will first establish a clear responsibility transfer mechanism, refining safety responsibilities from the project management level down to each front-line operator, ensuring that safety requirements are implemented in all construction links such

as material entry, equipment operation, and process connection, without leaving any responsibilities unattended.

At the same time, safety management will also help on-site personnel stay vigilant about safety and standardize operational habits through regular safety training and technical disclosures. For example, it will clarify the requirements for wearing protective equipment during high-altitude operations and the inspection steps before mechanical startup, fundamentally reducing hidden dangers caused by non-standard operations or insufficient safety awareness. In addition, considering that on-site construction conditions are constantly changing, safety management will conduct real-time hazard investigations and form a closed-loop management of "hazard discovery - rectification implementation - re-inspection confirmation." In high-risk links such as high-altitude operations, mechanical use, and temporary electricity use, potential problems are identified in a timely manner, and prevention and control measures are adjusted according to construction progress to prevent risks from accumulating and causing accidents[1].

3.2 Improving Engineering Quality and Construction Efficiency and Optimizing Project Resource Allocation

The core role of construction technology management in on-site construction is mainly reflected in accurately controlling engineering quality, scientifically improving construction efficiency, and then helping the project optimize resource allocation. In terms of quality control, construction technology management will first conduct in-depth drawing reviews and optimize construction plans to resolve in advance the mismatch between design drawings and on-site construction conditions. For example, adjusting the construction methods of complex structural nodes and clarifying the technical standards and quality bottom lines of each process to avoid rework due to design and actual disconnection later.

At the same time, for key processes such as steel bar binding, concrete pouring, and steel structure welding, construction technology management will arrange for dedicated personnel to provide technical guidance and conduct random inspections during construction to ensure that each step of operation complies with norms, reducing quality problems caused by inadequate technology and ensuring that the final completed engineering quality meets standards. In addition, construction technology management also emphasizes promoting technological innovation and application. It encourages the use of new technologies, new materials, and new processes to improve engineering quality and construction efficiency; regularly organizes technical exchanges and training to help the team master the latest technological methods; and establishes technical archives and databases to record the technical difficulties and solutions encountered in project construction and provide references for future projects. These practices can not only reduce additional costs caused by rework later but also shorten the project duration, enabling the project to achieve dual objectives of quality and progress within a controllable cost range.

3.3 Strengthening Enterprise Core Competitiveness and Assisting in High-quality Development of the Industry

The collaborative promotion of safety and construction technology management not only has direct value for individual projects but also strengthens the core competitiveness of construction enterprises from a long-term perspective and provides support for high-quality development of the industry. From the enterprise level, perfect safety management and efficient technology management can help enterprises create high-quality project cases, establish a good market reputation, and enhance competitiveness in bidding. At the same time, through the accumulation of management practices and methods, an internal management standard system can be formed within the enterprise, reducing the management costs of subsequent projects and improving overall operational efficiency. From the industry level, the popularization and optimization of safety and construction technology management can drive the industry to get rid of the traditional extensive management model of "emphasizing progress over safety" and "emphasizing experience over technology" and guide enterprises to transform towards standardized, refined, and digital management.

4. Positive Countermeasures to Strengthen Safety and Construction Technology Management on Construction Sites

4.1 Building a Collaborative Management System and Strengthening Responsibility Closure and Process Connection

To strengthen safety and construction technology management on construction sites, the primary task is to break down the barriers between management modules and build a collaborative management system of "safety - technology - progress - cost." On the one hand, it is necessary to clarify the core responsibilities and connection nodes of each management module and establish a cross-departmental communication mechanism. For example, during the construction plan formulation stage, both the safety management department and the technology management department are required to participate in the review and put forward opinions from the perspectives of safety risk prevention and control and technical feasibility to ensure that the plan not only meets technical standards but also avoids safety hazards. During the hazard investigation process, it is stipulated that the safety management department must synchronize the investigation results to the technology department, and the technology department should adjust construction processes or protective measures accordingly, forming a closed-loop process of "investigation - feedback - optimization - verification." On the other hand, it is necessary to strengthen the responsibility transfer mechanism, refine management responsibilities to specific positions and individuals, clarify the management responsibilities from the project leader to the front-line team leader, and ensure that management requirements are implemented layer by layer through signing responsibility letters and regular assessments. At the same time, it is necessary to optimize management processes according to project actual conditions and simplify unnecessary approval links to improve management efficiency. For example, for minor technical adjustments, a graded approval system can be formulated to avoid long processes affecting construction progress and enable the collaborative management system to be both standardized and adaptable to on-site dynamic needs[2].

4.2 Improving the Full-cycle Personnel Training System and Enhancing Comprehensive Literacy and Management Abilities

Personnel are the core executors of on-site management. Strengthening safety and construction technology management requires starting with personnel training and building a full-cycle training system covering "selection - training - assessment - improvement." In the selection process, it is necessary to clarify the ability standards for different positions. For example, for technical managers, in addition to requiring professional technical qualifications, their ability to identify safety risks should also be assessed. For front-line operators, priority should be given to selecting those with safety operation experience and awareness of norms to improve the basic literacy of the team from the source. In terms of training, it is necessary to design targeted training content according to different position types. For managers, focus on training in modern management concepts, collaborative management methods, and new technology applications to help them get rid of traditional experience dependence and master scientific management tools. For technicians, strengthen training in new technologies, new processes, and new norms, especially content related to safety management connections such as safety technical disclosures and risk prediction, to improve their ability to adapt technical solutions to safety requirements. For front-line operators, regularly conduct training on safety operation norms and hazard identification methods, and strengthen safety awareness through case explanations and practical exercises, changing from "passive obedience" to "active prevention and control." In addition, it is necessary to establish a dynamic assessment mechanism, link training effects with job promotion and salary adjustments, retrain or adjust the positions of those who fail to meet the assessment standards, and provide advanced learning opportunities for outstanding personnel, such as participating in industry technical exchanges and special project research, to continuously improve personnel's comprehensive literacy and provide talent support for on-site management.

4.3 Promoting the Deep Integration of Technology and Management and Accelerating Digital Transformation and Application Landing

In the context of digital development, strengthening on-site management requires promoting the deep integration of technological tools and management needs and using digital means to improve the accuracy and efficiency of safety and construction technology management. First, it is necessary to formulate a technology application plan based on on-site management pain points and clarify the application scenarios and objectives of different technological tools. For example, for dynamic risk monitoring in safety management, intelligent monitoring equipment can be introduced to collect real-time risk data in key scenarios such as high-altitude operations and deep foundation pit construction and achieve risk warnings through system analysis. For drawing reviews and plan optimization in technology management, the full-process application of BIM technology can be promoted to achieve functions such as drawing visualization, process simulation, and collision detection, and identify design and construction conflicts in advance to reduce rework later. Second, it is necessary to break down the data barriers of technological tools and promote data interconnection between different systems. For example, integrate the data of the safety monitoring system, technology management system, and progress management system into a unified platform to achieve real-time data sharing and linkage analysis, enabling managers to intuitively grasp the project's safety status, technical progress, and quality situation through the platform and improve overall control capabilities. At the same time, it is necessary to strengthen the technology application training of grassroots managers, conduct practical training on the introduced digital tools, simplify operation processes, and prepare easy-to-understand operation manuals to ensure that managers can skillfully use technological tools to carry out work. In addition, a technology application assessment mechanism can be established to regularly analyze the application effects of technological tools and adjust and optimize them according to on-site needs to avoid technology application becoming a mere formality and truly make digital technology the core support for improving the effectiveness of on-site safety and construction technology management[3].

5. Conclusion

In conclusion, safety and construction technology management in on-site construction of building engineering are key supports that determine project success and core levers that drive the transformation of the construction industry from "extensive" to "refined." In actual engineering practice, construction enterprises need to abandon the misconception of "emphasizing form over implementation" and integrate these countermeasures into the full-cycle management of the project. This will continuously avoid on-site construction risks, ensure engineering quality and personnel safety, reduce management costs, improve project benefits, win market competitiveness for enterprises, and provide solid guarantees for high-quality development of the construction industry.

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